DETAILED DESCRIPTION

[Detailed Description of the Invention]
[Field of the Invention]
[0001]
This invention relates to the manufacturing method, the electrostrictive actuator, liquid jet head, and fluid injector of the electrostrictive actuator using the piezo-electric effect of the piezo electric crystal film.
[Background of the Invention]
[0002]
From the former, there is an ink jet type recording head as an example of a liquid jet head, for example. In this ink jet type recording head, the electrostrictive actuator using the piezo-electric effect of the piezo electric crystal film is used as a driving source of the ink discharge of a printer. This electrostrictive actuator is provided with the piezo electric crystal element which is generally formed on the nozzle orifice (delivery) which carries out the regurgitation of the drop (ink droplet), the diaphragm which constitutes a part of pressure generating room open for free passage, and this diaphragm, and has a lower electrode, a piezo electric crystal layer, and an upper electrode, and is constituted. In such an ink jet type recording head, the stable drop regurgitation characteristic is obtained and various improvements aiming at improving reliability are made.
[0003]
As such an ink jet type recording head, For example, have a joined substrate in which the drive circuit which it is open for free passage to a nozzle orifice, and is joined to the piezo electric crystal film side of the passage formation substrate provided with at least two rows of sequences of the pressure generating room formed by two or more septa, and makes a piezo electric crystal layer drive is mounted, and. The drawer wiring which the breakthrough which penetrates the joined substrate concerned to a thickness direction is provided in the portion corresponding to between the sequences of said pressure generating room of this joined substrate, and is pulled out from each of each piezo electric crystal layer is installed to the portion corresponding to said breakthrough, and. By electrically connecting drawer wiring concerned and said drive circuit with the conductive wire installed via said breakthrough, the area of a breakthrough is stopped small and there are some which attained the miniaturization. (Refer to patent documents 1).

[0004]
When manufacturing the conventional ink jet type recording head mentioned above, the following methods are usually adopted. That is, the elastic membrane which oxidizes thermally the wafer of the silicon single crystal substrate used as a passage formation substrate with about 1100 ** diffusion furnace, and consists of diacid-ized silicon is formed. Next, after forming the film for lower electrode formation by sputtering process all over this elastic membrane, this film for lower electrode formation is patterned, and a lower electrode is formed. Subsequently, after forming a piezo electric crystal film with a sol-gel method on the elastic membrane in which the lower electrode was formed, this piezo electric crystal film is calcinated and crystallized at the temperature of about 600-1000 ** under atmospheric air or oxygen environment. Next, a desired process is performed and an ink jet type recording head is manufactured, such as forming Pt, Ir, etc. by sputtering process, forming the film for upper electrode formation, patterning this film for upper electrode formation, and a piezo electric crystal film, and forming an upper electrode and a piezo electric crystal layer.
[Patent documents 1] JP,2003-246065,A
[Description of the Invention]
[Problem(s) to be Solved by the Invention]
[0005]
However, in the conventional ink jet type recording head mentioned above, the adhesion of a piezo electric crystal layer and an upper electrode is not enough, there is a possibility that fault, like an upper electrode separates easily may arise, and the yield and reliability may have fallen. Then, if adhesion with a piezo electric crystal layer uses substrate metals (closely adhered film), such as good Ti, as an upper electrode, a substrate metal will oxidize and it will become difficult to acquire sufficient piezoelectric property.
[0006]
In this structure, it was easy to generate a low dielectric layer between the piezo electric crystal layer and the upper electrode, and there was also a possibility that sufficient piezoelectric property might not be acquired. Then, since a low dielectric layer is prevented from occurring between a piezo electric crystal layer and an upper electrode, before forming the film for upper electrode formation by sputtering process, it is possible but to perform a reverse sputtering process, and. If this reverse sputtering process is performed, the presentation of the surface of a piezo electric crystal layer will change, and there is a possibility that piezoelectric property may fall.
[0007]
This invention is made in view of such a situation, and is a thing.
It is providing the manufacturing method of the electrostrictive actuator which has the purpose and whose adhesion of a piezo electric crystal layer and an upper electrode improved.

[0008]
An object of this invention is to provide the electrostrictive actuator which has the outstanding piezoelectric property and whose adhesion of a piezo electric crystal layer and an upper electrode improved.
[Means for Solving the Problem]

[0009]
A process from which this invention constitutes a film for upper electrode formation in order to attain this purpose, To what provides a manufacturing method of an electrostrictive actuator including a process of patterning said piezo electric crystal film and a film for upper electrode formation, and forming a piezo electric crystal layer and an upper electrode. A manufacturing method of an electrostrictive actuator provided with a diaphragm containing a lower electrode characterized by comprising the following formed on an insulator layer and the insulator layer concerned, a piezo electric crystal layer formed on the diaphragm concerned, and an upper electrode formed on the piezo electric crystal layer concerned.
A process of forming an insulator layer on a substrate.
A process of forming a lower electrode on said insulator layer.
A process of forming a piezo electric crystal film on said lower electrode.
It lets a process of forming the 1st conducting film on said piezo electric crystal film, and said 1st conducting film pass, and ion is driven into an interface of said piezo electric crystal film and the 1st conducting film at least, a conductive layer is formed, and it is the 1st conducting film concerned and conductive layer.

[0010]
According to the manufacturing method of an electrostrictive actuator including these processes, it lets the 1st conducting film formed on said piezo electric crystal film pass, A conductive layer is formed by driving ion into an interface of piezo electric crystal film concerned and the 1st conducting film at least, and since a film for upper electrode formation provided with the 1st conducting film concerned and conductive layer is constituted, the film for upper electrode formation concerned does not separate from a piezo electric crystal film. Therefore, the adhesion of a piezo electric crystal layer and an upper electrode which are formed behind can be raised. A dielectric layer set to one of the causes which reduces the piezoelectric property of the piezo electric crystal layer concerned to an interface of a piezo electric crystal layer and an upper electrode further again is not formed. Therefore, outstanding piezoelectric property can be provided.
[0011]
In a manufacturing method of an electrostrictive actuator concerning this invention, the process of forming said 1st conducting film can include a process of forming a closely adhered film on said piezo electric crystal film, and a process of forming the 2nd conductive film on the closely adhered film concerned. By doing in this way, the adhesion of said film for upper electrode formation and a piezo electric crystal film can be raised further. An interface of a piezo electric crystal film and the 1st conducting film is an interface of a piezo electric crystal film and a closely adhered film in this case.
[0012]
And by a manufacturing method of an electrostrictive actuator concerning this invention, said ion can be further driven into the 1st [of said piezo electric crystal film / said] conducting film side again. According to this process, a layer by the side of the 1st [of a piezo electric crystal film] conducting film also turns into a conductive layer including said interface.
[0013]

This invention provides an electrostrictive actuator which it comes to manufacture by a manufacturing method of an electrostrictive actuator concerning this invention. This electrostrictive actuator can combine both the outstanding adhesion of a piezo electric crystal layer and an upper electrode, and outstanding piezoelectric property.

[0014]

This invention provides a liquid jet head provided with a delivery which is open for free passage in a pressure generating room where content volume changes, and said pressure generating room, and carries out the regurgitation of the drop with mechanical displacement of an electrostrictive actuator concerning this invention, and said electrostrictive actuator.

[0015]

This invention provides further again a fluid injector provided with a liquid jet head concerning this invention, and a drive which drives said liquid jet head.

[Effect of the Invention]

[0016]

According to the manufacturing method of the electrostrictive actuator concerning this invention, it lets the 1st conducting film formed on the piezo electric crystal film pass, A conductive layer is formed by driving ion into the interface of the piezo electric crystal film concerned and the 1st conducting film at least, and since the film for upper electrode formation provided with the 1st conducting film concerned and conductive layer is constituted, the upper electrode formed behind does not separate from a piezo electric crystal film. As a result, the adhesion of a piezo electric crystal layer and an upper electrode can be raised. The dielectric layer used as one of the causes which reduces the piezoelectric property of the piezo electric crystal layer concerned to the interface of a piezo electric crystal layer and an upper electrode is not formed. As a result, the electrostrictive actuator provided with the reliability which could improve the yield and was excellent can be manufactured.

[Best Mode of Carrying Out the Invention]

[0017]

Next, an electrostrictive actuator concerning the suitable embodiment of this invention and a manufacturing method for the same are explained with reference to drawings. The embodiment indicated below is illustration for explaining this invention, and does not limit this invention only to these embodiments. Therefore, this invention can be carried out with various gestalten, unless it deviates from the gist.

[0018]

The exploded perspective view of the liquid jet head provided with the electrostrictive actuator which drawing 1 requires for the suitable embodiment of this invention, and drawing 2, The sectional view showing a part of manufacturing process of the liquid jet head which shows drawing 1 the top view, drawing 3 - drawing 8 in which the part near the electrostrictive actuator of the liquid jet head shown in drawing 1 is shown, and drawing 9 are the perspective views showing the outline of an ink jet type recorder in which the liquid jet head shown in drawing 1 was carried.

[0019]

As shown in drawing 1 - drawing 8, as for the liquid jet head concerning this embodiment, the electrostrictive actuator 100 is allocated in the field corresponding to the pressure generating room 30

of the passage formation substrate 10 in which two or more pressure generating rooms 30 were formed. According to this embodiment, the silicon single crystal substrate of the plane direction (110) was used as the passage formation substrate 10. The 1-2-micrometer-thick elastic membrane (insulator layer) 25 which consists of the SiO_2 film 11 and the ZrO_2 film 12 is formed in one field of this passage formation substrate 10. The field of another side of the passage formation substrate 10 turns into an effective area.

[0020]

They are formed by two or more pressure generating rooms 30 formed in said effective area of the passage formation substrate 10 by carrying out anisotropic etching of the silicon single crystal substrate, and on the longitudinal direction outside. The communicating part 52 which constitutes some reservoirs which are open for free passage in the reservoir part 51 of the joint plate 24 mentioned later, and serve as a common ink chamber of each pressure generating room 30 is open for free passage via the ink feed path 53. The SiO_2 film 33 (refer to drawing 8) provided with the function as a protective film with the tolerance over the ink accommodated in the pressure generating room 30 is formed in said effective area of the passage formation substrate 10.

[0021]

The nozzle plate 36 in which the nozzle orifice 35 which is open for free passage in an opposite hand was drilled has adhered to the effective area side of the passage formation substrate 10 via a bonding agent, a hot welding film, etc. in the ink feed path 53 of each pressure generating room 30. This nozzle plate 36 covers the whole surface of the passage formation substrate 10 extensively in respect of one side, and the duty of the back up plate which protects a silicon single crystal substrate from a shock or external force also achieves it. It may be made for the passage formation substrate 10 and a coefficient of thermal expansion to form the nozzle plate 36 with the material same in abbreviation. In this case, since it becomes same omitting modification by the heat of the passage formation substrate 10 and the nozzle plate 36, it is easily joinable using a thermosetting bonding agent etc.

[0022]

Here, the size of the pressure generating room 30 which gives an expulsion-of-an-ink-droplet pressure to ink, and the size of the nozzle orifice 35 which carries out the regurgitation of the ink droplet are optimized according to the quantity of the ink droplet which carries out the regurgitation, discharging speed, and regurgitation frequency. For example, when recording 360 ink droplets per inch, it is necessary to form the nozzle orifice 35 with sufficient accuracy for a diameter of tens of micrometers.

[0023]

On the other hand, said effective area of the passage formation substrate 10 is on the elastic membrane 25 formed in the field of an opposite hand, and on the field in which the pressure generating room 30 is formed, as shown in drawing 8, the lower electrode 13, the piezo electric crystal layer 18, and the upper electrode 19 are formed. The lower electrode 13 constitutes the diaphragm with the elastic membrane 25. The upper electrode 19 comprises the 1st conducting film 15 and conductive layer 16. (Refer to drawing 6 - drawing 8). The electrostrictive actuator 100 is

constituted by the portion containing the diaphragm, the piezo electric crystal layer 18, and the upper electrode 19 which consist of this elastic membrane 25 and lower electrode 13. (Refer to drawing 1 and drawing 2).
[0024]
On the upper electrode 19, the protective film 20 for making it not degrade the piezo electric crystal layer 18 is formed of the moisture from the outside, and the upper electrode 19 is electrically connected with the wiring 22 via the contact hole 21 formed in the protective film 20. (Refer to drawing 7 and drawing 8).
[0025]
Although the lower electrode 13 is used as the common electrode of the electrostrictive actuator 100 and the upper electrode 19 is used as the individual electrode of the electrostrictive actuator 100 in this embodiment, it is convenient even if it makes this reverse on account of a drive circuit or wiring. In the case of which, the electrostrictive actuator 100 will be formed every pressure generating room 30.
[0026]
The joint plate 24 is allocated in the field (upper surface as used in the field of drawing 1) of an opposite hand with the field in which the nozzle plate 36 of the passage formation substrate 10 was allocated. The reservoir part 51 which constitutes some reservoirs is formed in this joint plate 24. This reservoir part 51 penetrates the joint plate 24 to a thickness direction, is continued and formed crosswise [of the pressure generating room 30], and constitutes the reservoir which is opened for free passage with the communicating part 52 of the passage formation substrate 10, and serves as a common ink chamber of each pressure generating room 30 from this embodiment.
[0027]
The electrostrictive actuator attaching part 54 which secured the space of the grade which does not check movement of the electrostrictive actuator 100 is formed in the field which counters the electrostrictive actuator 100 of the joint plate 24 corresponding to the pressure generating room 30, respectively. This space does not need to be sealed even if sealed.
[0028]
Although the electrostrictive actuator attaching part 54 is formed for every sequence of the electrostrictive actuator 100, it may be made to form this electrostrictive actuator attaching part 54 independently every electrostrictive actuator 100 in this embodiment. As for such a joint plate 24, it was preferred to use the material same in the coefficient of thermal expansion of the passage formation substrate 10 and abbreviation, for example, glass, the charge of a ceramic material, etc., and it formed it by this embodiment using the passage formation substrate 10 and the silicon single crystal substrate of an identical material.
[0029]
The breakthrough 55 which penetrates the joint plate 24 to a thickness direction is formed in the field which counters between the approximately center parts of the joint plate 24, i.e., the sequence of the pressure generating room 30. The drive circuits 110, such as the circuit board for driving each electrostrictive actuator 100 or an integrated circuit (IC), are mounted, respectively in the both sides of the breakthrough 55 of the joint plate 24, i.e., the portion corresponding to each sequence of the

pressure generating room 30. For example, in this embodiment, each drive circuit 110 mounted in the both sides of the breakthrough 55 is for driving the electrostrictive actuator 100 provided in the field which counters each drive circuit 110.

[0030]

The liquid jet head concerning this embodiment incorporates ink from the ink introduction port linked to the ink feed means of the exterior which is not illustrated, After filling an inside with ink from a reservoir to the nozzle orifice 35, According to the record signal from the drive circuit 110, with the mechanical displacement which impresses voltage between each lower electrode 13 and upper electrode 19 corresponding to the pressure generating room 30, and is produced according to the piezo-electric effect of the piezo electric crystal layer 18. By bending and changing the diaphragm which consists of the lower electrode 13 and the elastic membrane 25, the content volume of the pressure generating room 30 is changed, the pressure in each pressure generating room 30 is heightened, and an ink droplet carries out the regurgitation from the nozzle orifice 35.

[0031]

This liquid jet head constitutes a part of recording head unit possessing an ink cartridge etc. and an ink passage open for free passage, and is carried in an ink jet type recorder.

[0032]

As shown in drawing 9, the recording head units 1A and 1B which have a liquid jet head specifically, The carriage 3 which the cartridge 2A and 2B which constitute an ink feed means were provided removable, and carries these recording head units 1A and 1B is established in the carriage shaft 5 attached to the device main frame 4, enabling free axial movement. These recording head units 1A and 1B shall carry out the regurgitation of a black ink constituent and the color ink constituent, respectively, for example. And the carriage 3 which carries the recording head units 1A and 1B is moved along with the carriage shaft 5 by being transmitted to the carriage 3 via two or more gears and timing belts 7 which the driving force of the drive motor 6 does not illustrate. Along with the carriage shaft 5, the platen 8 is formed in the device main frame 4, and record sheet S which is recording media, such as paper to which paper was fed by the feed roller etc. which are not illustrated, has the platen 8 top conveyed on the other hand.

[0033]

Next, the manufacturing process of the liquid jet head provided with the electrostrictive actuator concerning this embodiment is explained with reference to drawings.

[0034]

First, the SiO_2 film 11 is formed by thermal oxidation like the process shown in drawing 3, for example on the silicon single crystal substrate used as the passage formation substrate 10. Next, the ZrO_2 film 12 is formed on this SiO_2 film 11. In this embodiment, the SiO_2 film 11 and the ZrO_2 film 12 turn into the elastic membrane (insulator layer) 25. Subsequently, the film for lower electrode formation is formed by sputtering process on the elastic membrane 25, it patterns after the shape of a request of this and the lower electrode 13 is formed. As a material which constitutes the lower electrode 13, Ti, Ir, Pt, etc. can use a desired conductive material, for example.

[0035]

Next, in the process shown in drawing 4, a piezo electric crystal precursor film is formed by predetermined thickness with a sol-gel method on the passage formation substrate 10 in which the lower electrode 13 was formed. Subsequently, the passage formation substrate 10 in which this piezo electric crystal precursor film was formed is calcinated and crystallized at the temperature of not less than about 600 ** under atmospheric air or oxygen environment. By the ability to calcinate at such an elevated temperature, crystallization with the sufficient piezo electric crystal film 14 is made.

[0036]

Here, as for the piezo electric crystal film 14, it is preferred that the crystal is carrying out orientation. For this reason, in this embodiment, spreading desiccation is carried out, what is called sol that dissolved and distributed the metal organic matter at the catalyst is gelled, for example, the piezo electric crystal precursor film which does not have crystallinity is formed, it consists of metallic oxides by calcinating a piezo electric crystal precursor film at an elevated temperature further, and the piezo electric crystal film 14 which has crystallinity is obtained. As a material of this piezo electric crystal film 14, the material of a lead-zirconate-titanate system, etc. can use it conveniently, for example. The method for film deposition in particular of this piezo electric crystal film 14 is not limited, for example, may be formed by sputtering process. The method of carrying out crystal growth at low temperature after forming the piezo electric crystal precursor film of lead zirconate titanate by sol-gel method or sputtering process by the high-pressure-treatment method in the inside of an alkaline aqueous solution may be used.

[0037]

Unlike the piezo electric crystal of bulk, the crystal is carrying out priority orientation of the piezo electric crystal film 14 formed in this way, and, as for the piezo electric crystal film 14, the crystal is formed pillar-shaped in this embodiment. The state where it is suitable in the direction the orientation direction of the direction of a crystal is not disorderly [priority orientation] and the specific crystal face of the direction is almost constant is said. The thin film with a pillar-shaped crystal refers to the state where the crystals of an approximate circle prism continue and gather to a plane direction where a medial axis is abbreviated-coincided with a thickness direction, and they form the thin film. Of course, it may be the thin film formed as the granular crystal which carried out priority orientation. In this embodiment, the thickness of the piezo electric crystal film 14 was 0.2-5 micrometers.

[0038]

Next, the 1st conducting film 15 is formed by about 10-200-nm thickness on the piezo electric crystal film 14 by sputtering process. As a material which constitutes the 1st conducting film 15, Ir, IrO, Pt, W, Ta, Mo, etc. can use a desired conductive material, for example. In this process, reverse sputtering process can also be performed as pretreatment.

[0039]

Next, in the process shown in drawing 5, it lets the 1st conducting film 15 obtained at the process shown in drawing 4 pass, and ion is driven into the interface of the 1st conducting film 15 and the piezo electric crystal film 14 at least. Ion was driven also into the upper-levels [of the piezo electric crystal film 14] 15, i.e., 1st conducting film of piezo electric crystal film 14, side in this embodiment. Ion was driven also into the 1st conducting film 15. At this embodiment, placing (ion implantation) of this ion was performed by Al ion, placing voltage 300Kev, amount of placing (dose):1x10 ^{19} - a 1x10

^{21} individual / cm^2 grade. As ionic species to drive in, Ti, Ir, Pt, Pd, Mo, W, etc. are mentioned, for example. The field where this ion was driven in serves as the conductive layer 16. Subsequently, heat treatment for about 20 minutes is performed for the passage formation substrate 10 into which ion was driven at the temperature of about 300-400 **, for example, and the conductive layer 16 is stabilized. Thus, the film 17 for upper electrode formation which consists of the 1st conducting film 15 and conductive layer 16 is constituted.

[0040]

Thus, in order to form the conductive layer 16 by what ion is driven into the interface of the 1st conducting film 15 and the piezo electric crystal film 14 for at least (it pours in) and to form the film 17 for upper electrode formation with the 1st conducting film 15, The adhesion of the piezo electric crystal layer 18 and the upper electrode 19 which the film 17 for upper electrode formation does not separate from the piezo electric crystal film 14, and are formed behind as a result can be improved.

[0041]

Next, in the process shown in drawing 6, the piezo electric crystal film 14 and the film 17 for upper electrode formation are patterned by the photolitho method, and the piezo electric crystal layer 18 and the upper electrode 19 are formed. Thus, the electrostrictive actuator 100 which serves as a diaphragm which consists of the elastic membrane 25 and the lower electrode 13, and the piezo electric crystal layer 18 from the upper electrode 19 is formed.

[0042]

Next, in the process shown in drawing 7, the protective film 20 which consists of an $aluminum_2O_3$ film is formed on the passage formation substrate 10 in which the electrostrictive actuator 100 was formed. Subsequently, after carrying out the opening of the contact hole 21 to a joined part with the upper electrode 19 of the protective film 20 and forming the film for wiring formation on this protective film 20, this film for wiring formation is patterned and the wiring 22 electrically connected with the upper electrode 19 via the contact hole 21 is formed. As a material which constitutes the wiring 22, aluminum/TiW, Au/NiCr, etc. can be used conveniently, for example.

[0043]

Next, in the process shown in drawing 8, the joint plate 24 is joined on the passage formation substrate 10 obtained at the process shown in drawing 7. Subsequently, to the near field where the joint plate 24 of the passage formation substrate 10 was joined, etching removal of the field of an opposite hand is carried out selectively, and the pressure generating room 30 is formed with it. Next, the SiO_2 film 33 which has the tolerance over the ink accommodated in the pressure generating room 30 etc. with plasma CVD method is formed in the near field in which the pressure generating room 30 of the passage formation substrate 10 was formed by about 0.1 micrometer of thickness. Then, with the near field where the joint plate 24 of the passage formation substrate 10 was joined, desired processes, such as joining the nozzle plate 36 where the nozzle orifice 35 was drilled in the field of the opposite hand, are performed, and the liquid jet head shown in drawing 1 is completed.

[0044]

Although the process shown in drawing 4 explained the case where the 1st conducting film 15 was formed on the piezo electric crystal film 14, at this embodiment, Not only this but the closely adhered

film 26 which has conductivity on the piezo electric crystal film 14 as shown in drawing 10 for example, may be formed by about 0.1-10-nm thickness, for example, and the 2nd conducting film 27 may be formed by about 10-200-nm thickness on this closely adhered film 26, for example. In this case, the adhesion of the piezo electric crystal film 14 and the 2nd conducting film 27 can be raised, and as a material which constitutes the closely adhered film 26, especially if usable as wiring, it will not be limited, but Ti, Cr, TiW, TiN, NiCr, etc. can be used conveniently, for example. As the 2nd conducting film 27, the same material as the 1st conducting film 15 can be used conveniently.

[0045]

When the process shown in drawing 10 is performed next, as shown in drawing 11, it can let the closely adhered film 26 and the 2nd conducting film 27 pass, and the process of driving ion into the interface of the closely adhered film 26 and the piezo electric crystal film 14 at least can be performed, for example. Also in this case, ion can be driven also into the upper-levels [of the piezo electric crystal film 14] 26, i.e., closely adhered film of piezo electric crystal film 14, side, for example. Ion can be driven also into the closely adhered film 26 and the 2nd conducting film 27. And the field where this ion was driven in serves as the conductive layer 16 like the embodiment mentioned above. Subsequently, the conductive layer 16 is stabilized like the above and the film 17 for upper electrode formation which consists of the 2nd conducting film 27, closely adhered film 26, and conductive layer 16 is constituted.

[0046]

Although this embodiment explained the case where the elastic membrane (insulator layer) 25 provided with the two-layer structure of the SiO_2 film 11 and the ZrO_2 film 12 was formed, If not only this but the elastic membrane 25 has an insulating function and does not spoil the function of an electrostrictive actuator, a formation material in particular is not limited and it can determine structure, three etc. layer systems or more, etc. arbitrarily further.

[0047]

And by this embodiment, in order to form the conductive layer 16, ion was driven in again, but this ion drives in a kind of ion, such as Ir, Pt, W, Ta, and Mo, as mentioned above, and also it may also drive in two sorts of ion, such as Mo/Si, W/Si, Ti/N, and Ti/W. And it may be devoted to the lower layer portion of the conductive layer 16 by the concentration of a request of the 1st ion, and the 2nd ion may also be driven into it at high concentration rather than the 1st ion again at the upper layer (surface side). In this case, different ion may be sufficient as the 1st ion and 2nd ion, and the same ion may be sufficient as them. Ion implantation (pouring) conditions are not limited to the conditions mentioned above, and a request can determine them. Ion implantation conditions driven into the 1st conducting film 15, the 2nd conducting film 27, and the closely adhered film 26, such as quantity, placing voltage, etc. of ion, can be determined arbitrarily.

[0048]

Although this embodiment explained further again the case where the SiO_2 film 33 was formed as a protective film which has the tolerance over the ink accommodated in the pressure generating room 30, Not only this but this protective film can choose arbitrarily those formation materials, such as a SiN_X film and a TaO_X film, for example. It can also be considered as the multilayer structure which

consists of a different material film.

[0049]

According to this embodiment, it is applicable to the actuator device carried not only in the actuator carried in such a liquid jet head (ink jet type recording head) as a fluid discharging means but in all devices. For example, an actuator device is applicable to a sensor other than the head mentioned above, etc. This invention is aimed large at a fluid injector a liquid jet head and at large although this embodiment explained as an example the ink jet type recording head which carries out the regurgitation of the ink as a liquid jet head. The recording head used for image recorders, such as a printer, as a liquid jet head, for example, The electrode material jet head used for electrode formation, such as the color material jet head and organic EL display which are used for manufacture of light filters, such as a liquid crystal display, and FED (surface light display), the living body organic matter jet head used for bio-chip manufacture, etc. can be mentioned.

[Brief Description of the Drawings]

[0050]

[Drawing 1]It is an exploded perspective view of the liquid jet head provided with the electrostrictive actuator concerning the suitable embodiment of this invention.

[Drawing 2]It is a top view showing the part near the electrostrictive actuator of the liquid jet head shown in drawing 1.

[Drawing 3]It is a sectional view showing a part of manufacturing process of the liquid jet head shown in drawing 1.

[Drawing 4]It is a sectional view showing a part of manufacturing process of the liquid jet head shown in drawing 1.

[Drawing 5]It is a sectional view showing a part of manufacturing process of the liquid jet head shown in drawing 1.

[Drawing 6]It is a sectional view showing a part of manufacturing process of the liquid jet head shown in drawing 1.

[Drawing 7]It is a sectional view showing a part of manufacturing process of the liquid jet head shown in drawing 1.

[Drawing 8]It is a sectional view showing a part of manufacturing process of the liquid jet head shown in drawing 1.

[Drawing 9]It is a perspective view showing the outline of an ink jet type recorder in which the liquid jet head shown in drawing 1 was carried.

[Drawing 10]It is a sectional view showing a part of manufacturing process concerning other embodiments of this invention.

[Drawing 11]It is a sectional view showing a part of manufacturing process concerning other embodiments of this invention.

[Description of Notations]

[0051]

10 A passage formation substrate, an 11 SiO_2 film, and a 12ZrO_2 film, 13 A lower electrode and 14

[The film for upper electrode formation, and 18 / A piezo electric crystal layer and 19 / An upper electrode and 25 / Elastic membrane and 30 / A pressure generating room and 100 electrostrictive

actuators] A piezo electric crystal film and 15 The 1st conducting film and 16 A conductive layer and 17

[Translation done.]